CLAIMS

What is claimed is:

1. An actuator mechanism comprising:

an actuator body comprising surfaces that define an actuation chamber wherein at least one of said surfaces is a membrane seat surface that has a perimeter;

a membrane comprising a shape memory alloy that has a martensite-austenite transition temperature, said membrane comprising an active side and an inactive side, said membrane being located over said membrane seat surface in said actuation chamber and being of sufficient size to divide said actuation chamber into a pump chamber located between said membrane seat surface and the active side of said membrane and an idle chamber located on the inactive side of said membrane, said membrane being movable from an undistorted form to a distorted form when a bias force is applied to the active side of said membrane when said membrane is at a temperature that is below said martensite-austenite transition temperature and wherein the volume of said pump chamber when said membrane is in said distorted form is greater than the volume of said pump chamber when said membrane is in said undistorted form;

at least one inlet located in said membrane seat surface through which fluid is introduced into said pump chamber;

at least one outlet located in said membrane seat surface through which fluid is removed from said pump chamber, said outlet being located at a spaced location from said inlet;

a bias pressure applicator that introduces said fluid into said pump chamber at a temperature that is below said martensite-austenite transition temperature and at a bias force that is sufficient to move said membrane from the undistorted form to the distorted form, said bias pressure applicator including an inlet flow control mechanism to prevent fluid from flowing from said pump chamber back through said inlet;

a heating system that provides for heating of said membrane to an actuation temperature that is above said martensite-austenite transition temperature

when said membrane is in said distorted form wherein said membrane at said actuation temperature exerts a pumping force against the fluid in said fluid chamber that is greater than the bias force applied to said liquid by said bias pressure actuator to thereby move liquid out of said pump chamber through said outlet; and

an outlet flow control mechanism to prevent fluid from flowing from said outlet back into said pump chamber.

2. An actuator mechanism according to claim **1** wherein at least two outlets are located in said membrane seat surface.

3. An actuator mechanism according to claim **1** wherein said inlet is located in the center of said membrane seat surface and said outlet is located towards the perimeter of said membrane seat surface.

4. An actuator mechanism according to claim **2** wherein said inlet is located in the center of said membrane seat surface and said outlets are located towards the perimeter of said membrane seat surface.

5. An actuator mechanism according to claim **4** wherein said membrane seat surface has a circular perimeter.

6. An actuator mechanism according to claim **1** wherein said membrane seat surface is in the form of a dome that extends inwardly into said actuation chamber.

7. An actuator mechanism according to claim **6** wherein said inlet is located in the center of said dome-shaped membrane seat surface.

8. An actuator mechanism according to claim **7** wherein said outlet is located towards the perimeter of said dome.

9. An actuator mechanism according to claim **6** wherein at least two outlets are located in said membrane seat surface and wherein said outlets are located towards the perimeter of said dome.

10. An actuator mechanism according to claim **9** wherein said outlets are spaced equidistantly around the perimeter of said dome.

11. An actuator mechanism according to claim **1** wherein said heating system includes a system for applying an electrical current to said membrane to provide heating thereof.

12. An actuator mechanism according to claim **1** wherein said inlet flow control mechanism comprises an inlet pressure check valve that prevents flow of fluid from said pump chamber out through said inlet when said fluid in said pump chamber is under said pumping force.

13. An actuator mechanism according to claim **1** wherein said outlet flow control mechanism comprises an outlet pressure check valve that prevents flow of fluid from said outlet back into said pump chamber wherein said fluid in said pump chamber is under said bias force.

14. A method for pumping fluid comprising the steps of:

A) providing an actuator mechanism comprising:

an actator body comprising surfaces that define an actuation chamber wherein at least one of said surfaces is a membrane seat surface that has a perimeter;

a membrane comprising a shape memory alloy that has a martensite-austenite transition temperature, said membrane comprising an active side and an inactive side, said membrane being located over said membrane seat surface in said actuation chamber and being of sufficient size to divide said actuation chamber into a pump chamber located between said membrane seat surface and the active side of said membrane and an idle chamber located on the inactive side of said membrane, said membrane being movable from an undistorted form to a distorted form when a bias force is applied to the active side of said membrane when said membrane is at a

temperature that is below said martensite-austenite transition temperature and wherein the volume of said pump chamber when said membrane is in said distorted form is greater than the volume of said pump chamber when said membrane is in said undistorted form;

at least one inlet located in said membrane seat surface through which the fluid to be pumped is introduced into said pump chamber;

at least one outlet located in said membrane seat surface through which said fluid is removed from said pump chamber, said outlet being located at a spaced location from said inlet;

B) introducing said fluid into said pump chamber at a temperature that is below said martensite-austenite transition temperature and at a bias force that is sufficient to move said membrane from the undistorted form to the distorted form,

C) heating said distorted membrane to an actuation temperature that is above said martensite-austenite transition temperature to exert a pumping force against the fluid in said fluid chamber that is greater than the bias force to thereby move liquid out of said pump chamber through said outlet.

15. A method for pumping fluid according to claim **14** wherein at least two outlets are located in said membrane seat surface.

16. A method for pumping fluid according to claim **14** wherein said inlet is located in the center of said membrane seat surface and said outlet is located towards the perimeter of said membrane seat surface.

17. A method for pumping fluid according to claim **15** wherein said inlet is located in the center of said membrane seat surface and said outlets are located towards the perimeter of said membrane seat surface.

18. A method for pumping fluid according to claim **17** wherein said membrane seat surface has a circular perimeter.

19. A method for pumping fluid according to claim **14** wherein said membrane seat surface is in the form of a dome that extends inwardly into said actuation chamber.

20. A method for pumping fluid according to claim **19** wherein said inlet is located in the center of said dome-shaped membrane seat surface.

21. A method for pumping fluid according to claim **20** wherein said outlet is located towards the perimeter of said dome.

22. A method for pumping fluid according to claim **20** wherein at least two outlets are located in said membrane seat surface and wherein said outlets are located towards the perimeter of said dome.

23. A method for pumping fluid according to claim **22** wherein said outlets are spaced equidistantly around the perimeter of said dome.

24. A method for pumping fluid according to claim **14** wherein said heating of said distorted membrane is accomplished by passing an electrical current through said membrane.

25. In a method for pumping a fluid wherein a membrane comprising a shape memory alloy is repeatedly heated and cooled, the improvement comprising cooling said membrane by introducing said fluid into contact with said membrane at an inlet location and flowing said liquid over said membrane to an outlet location that is spaced from said inlet location.

26. An improved method for pumping fluid according to claim **25** wherein said fluid is flowed from said inlet location over said membrane to at least two outlet locations.

27. An improved method for pumping fluid according to claim **26** wherein said inlet location is located at the center of the membrane and the outlet locations are located around the perimeter of the membrane.

28. An improved method for pumping fluid according to claim **27** wherein said outlet locations are located equidistantly around the perimeter of said membrane.

29. An actuator mechanism according to claim **1** wherein said actuator body includes at least two actuation chambers.